Raytheon

Customer Success Is Our Mission

Combined Environments Testing

JCAA/JG-PP Lead-Free Solder Project

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Topics

- What is Combined Environments Testing (CET)?
- CET Chamber
- CET Profile
- CET Steps

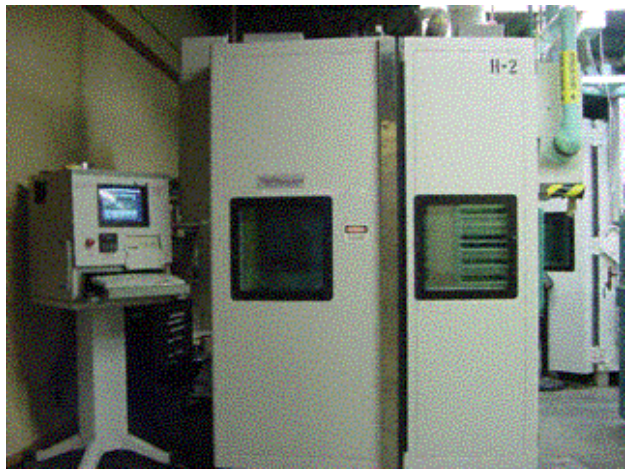
What is Combined Environments Testing?

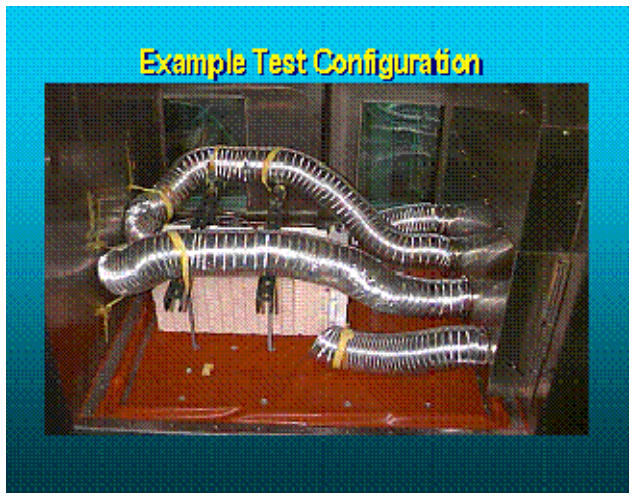
Raytheon

- Based on modified Highly Accelerated Life Test (HALT)
  - Goal: Quickly break products and learn from the failure modes
  - Identify design and process problems
  - Shorter time frame
  - Smaller number of test samples
  - Stressed beyond specification and typical use environments
    - Thermal extremes
    - Extreme thermal rates of change
    - Vibration
    - Combination of thermal and vibration
- Perceived Problems
  - Not a true life test (no modeling)
- Compare lead-free solder alloy performance against the standard tin lead eutectic solder

Combined Environments Chamber

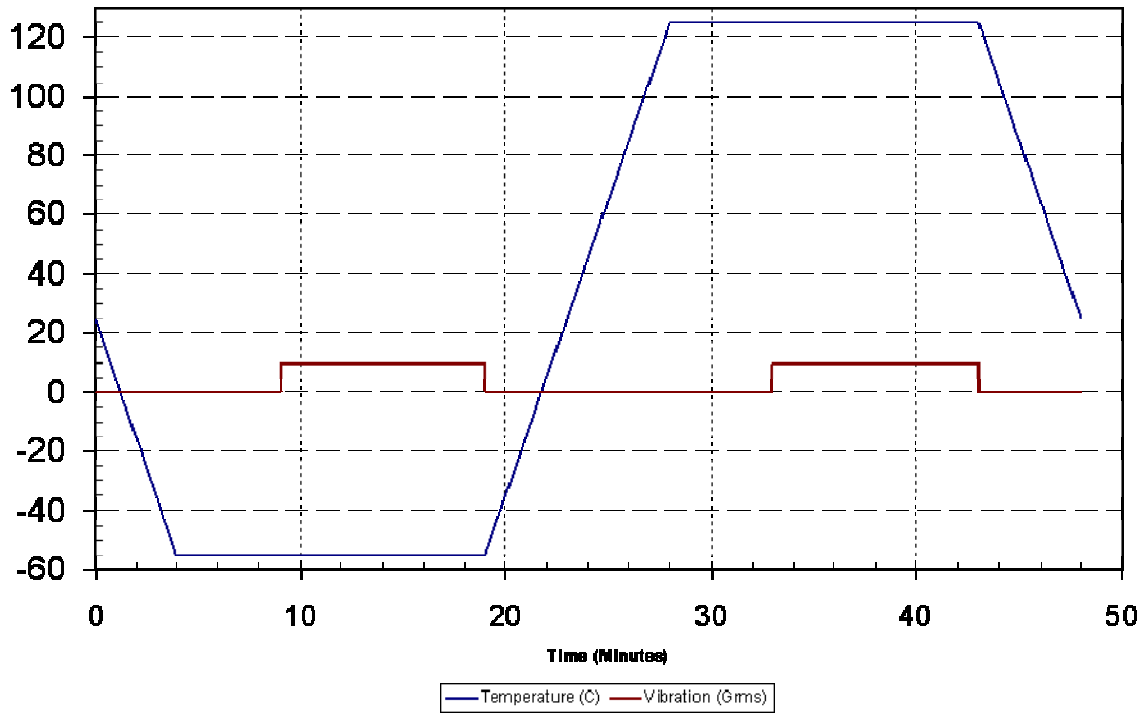
- QualMark HALT/HASS chamber located in McKinney, Texas
- Thermal
  - Liquid nitrogen for cooling
  - Nichrome heater elements for heating
  - Thermal capability ranges from -100 to 200 °C
  - Ramp rates of up to 60 °C per minute
- Vibration
  - Generated by pneumatically driven vibrators attached to the bottom of the table
  - Maximum levels of ≥ 60 Grms
  - 6 DOF application (linear and rotational)
- Thermal and vibration environments can be applied separately or combined





Combined Environments Test Parameters

- Thermal
  - -55 to 125 °C temperature cycle
  - 20 °C per minute ramp
  - 15 minute soak
- Vibration
  - During last 10 minutes of soak period
  - 10 Grms initial
  - Increase 5 Grms after 100 cycles
  - 20 Grms to significant failures
- Test Vehicles
  - 15 Manufacturing
  - 15 Repair



Combined Environments Testing Steps

- Test Setup
  - Fabricate fixture
  - Solder cables to test vehicles
  - Pretest inspection
- Execute Test
  - Test 3 lots of 10 test vehicles at a time
  - Utilize Anatech event detectors
  - Post test inspection
- Failure Analysis
  - Microsection analysis
- Data Analysis
- Publish Test Report